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Dated 14 May 2003

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference

551GB

2. Patent application number
(The Patent Office will fill in this part)

05 APR 2002

0207912.7

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Renishaw plc
New Mills
Wotton-under-Edge
Gloucestershire, GL12 8JR

Patents ADP number *(if you know it)*

2691002

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

Kinematic Coupling

5. Name of your agent *(if you have one)*

E C Leland et al

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Renishaw plc, Patent Department
New Mills
Wotton-under-Edge
Gloucestershire
GL12 8JR

Patents ADP number *(if you know it)*

08187429001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
–	–	–

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*
–	–

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

Yes

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	7
Claim (s)	0 DNC
Abstract	0
Drawing (s)	4 only

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature E Lelan Date 07.04.2002
AGENT FOR THE APPLICANT

12. Name and daytime telephone number of person to contact in the United Kingdom A ILES 01453 524524

Warning

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Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

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KINEMATIC COUPLING

The present invention relates to damping for kinematically coupled parts. In particular, the invention is suitable for damping of kinematically coupled parts of a touch probe.

Our earlier European patent 0501710 discloses a probe which comprises a sensing module and a stylus module held together by magnetic means, their relative positions being defined by kinematic elements. The stylus module holds a workpiece-contacting stylus, which is deflected on contact with a workpiece. The sensing module comprises a fixed structure which may be connected to the movable arm of a coordinate positioning machine and contains transducers which detects the deflection of the stylus. The modular nature of the probe enables the stylus modules to be exchanged, thus allowing different types of styli, for example different lengths of stylus, to be used.

This probe has the disadvantage that if very large styli are used the magnetic force required to retain the stylus module on the sensing module is also large. The large magnetic force has the effect that it causes an impact when the two modules are connected together which can upset the electronic transducers in the sensing module, causing them to become unreliable.

Furthermore, the impact can cause wear and damage to the kinematic elements of the modules which would affect the metrology of the system.

The present invention provides apparatus for releasably

connecting together two members comprising

a first member with a first surface;

a second member with a second surface to be releasably connected to the first surface of the first member;

a first set of elements on said first surface and a second set of elements on said second surface, said first and second elements co-operating to define the location of the second member with respect to the first member;

wherein a damper is provided on one of said first and second surfaces.

The damper reduces the impact when the two members are joined together.

Preferably the first and second members are releasably held together by magnetic means.

Preferably the damper comprises a housing in which a piston is located, said piston being biased to protrude from the housing and wherein the housing is filled with a viscous substance.

The damper may also comprise at least one guide means which assist in guiding the two members together. The at least one guide means may comprise at least one guide pin attached to the piston, said at least one guide pin being received by at least one corresponding recess in the other of the first and second members.

Preferably the first member is a sensing module of a probe and the second member is a stylus module of a probe.

A second aspect of the invention provides a probe comprising:

a retaining module with a first surface;

a task module with a second surface to be releasably connected to the first surface of the sensing module;

a first set of elements on said first surface and a second set of elements on said second surface, co-operating to define the location of the task module with respect to the retaining module;

wherein a damper is provided on one of said first and second surfaces.

A third aspect of the present invention provides a task module releasably connectable to a retaining module comprising:

a surface to be magnetically coupled to a retaining module;

a set of elements on said surface to cooperate with a corresponding set of elements on the retaining module to define the location of the task module with respect to the probe;

and a damper on the stylus module.

The retaining module and task module may for example comprise a probe head and probe respectively. Preferably the retaining module and task module comprise a sensing module and a stylus module of a probe.

Preferably the damper comprises a damper housing in the surface and a damper piston located in the damper housing biased to protrude from the housing. The housing is filled with a viscous substance to resist

movement of the damper piston within the damper housing.

Preferred embodiments of the invention will now be described by way of example, with reference to the accompanying drawing wherein:

Fig 1 shows a simplified internal view of the probe;

Fig 2 shows a cross-section of a part of the sensing module and the stylus module;

Fig 3 shows the plate of the stylus module;

Fig 4 shows the plate of the sensing module;

Fig 5 shows the a cross-section of a part of the sensing module and the stylus module of a second embodiment of the invention;

Fig 6 shows the plate of the stylus module of the second embodiment of the invention;

Fig 7 shows the plate of the sensing module of the second embodiment of the invention; and

Fig 8 shows the damper of the second embodiment of the invention.

Fig 1 shows a simplified view of an analogue probe 10 of the invention which is shown mounted on the movable arm 8 of a coordinate measuring machine (CMM) and which comprises a sensing module 12 and a stylus module 14. The stylus module 14 has a workpiece contacting stylus 16 and the sensing module 12 has electronic transducers (not shown) which measure the deflection of the stylus 16. The stylus module 14 is de-mountable from the sensing module 12 and may be removed and exchanged with other stylus modules, for example it may be exchanged with a stylus module having a longer stylus. The stylus module 14 is provided with a plate 18 which is

connectable to a mounting plate 20 of the sensing module 12. The plate 18 and mounting plate 20 are held together magnetically and are each provided with kinematic elements 22,24 to define the position of the stylus module 14 with respect to the mounting plate 20 of the sensing module 12 and ensure repeatability of location of the stylus module 14.

Figs 2-4 illustrate the stylus module 14 and part of the sensing module 12 of the probe in more detail. The sensing module 12 has a mounting plate 20 to which a plate 18 of the stylus module 14 is connected. The modules 12,14 have co-operating kinematic elements 22,24 to define the position of the plate 18 of the stylus module 14 on the mounting plate 20 of the sensing module 12. The kinematic elements 22,24 may comprise a set of three balls 22A spaced at 120° around the centre of the plate 18 which cooperate with a similarly spaced set of three pairs of radial parallel rollers 24A on the mounting plate 20 as shown in Figs 3 and 4. Alternative sets of elements may be used to define the position of the stylus module 14 with respect to the mounting plate 20. For example, the pairs of parallel rollers may be replaced by pairs of balls on one plate which co-operate with the single plate balls on the other plate.

The plate 18 and mounting 20 are held together by a strong magnet. Fig 2 shows a magnet 26 provided on the sensing module 12 and a keeper plate 28 provided on the stylus module 14.

A damper is provided between the sensing module 12 and stylus module 14 to cushion the impact when the two

modules are brought together.

Fig 2 shows a damper located in the retaining module. The damper comprises a damper piston 30 inserted in a damper housing 32 behind the mounting plate 20 of the sensing module 12. Three guide pins 34 are connected to the damper piston 30 and protrude through three apertures 36 in the mounting plate 20. The guide pins 34 and apertures 36 are spaced at 120° about the centre of the mounting plate 20.

A viscous substance 33 such as grease, oil or air is provided inside the damper housing 32 to provide resistance to movement of the damper piston 30. The damper piston 30 is biased away from the damper housing 32 by springs 38 between the damper housing 32 and the damper piston 30.

The stylus module 14 is provided with three recesses 40 to receive the guide pins 34. As the stylus module 14 is brought into contact with the sensing module 12, the guide pins 34 are inserted into their corresponding recesses 40 in the stylus module 14. The guide pins 34 are pushed back by the stylus module 14 and in turn push the damper piston 30 into the damper housing 32 which causes resistance due to the viscous damping effect of the grease.

The guide pins 34 have the added benefit that if the stylus module 14 is not correctly aligned with the sensing module 12, for example it might be tilted, the guide pins 34 assist in correctly aligning the stylus module 14 so that the kinematic elements 20,24 connect together.

In a second embodiment, as illustrated by figs 5-7, the damper is provided in the stylus module. Identical features with the previous embodiment use the same reference numbers. The keeping plate 28 in the stylus module plate 14 has a recess which accommodates the damper housing 32 and a damper piston 30 is located in this housing. As before the damper piston 30 is biased to protrude from the housing 32 by a spring 38 between the housing 32 and the damper piston 30. A viscous substance such as grease, oil or air is provided inside the damper housing 32. Thus when the stylus module 14 is brought into contact with the sensing module 12, the damper piston 30 is pushed by the mounting plate 20 of the sensing module 12 into the housing 32 against the viscous substance, lessening the impact and preserving the integrity of the transduced signals.

Fig 8 shows the damper in the second embodiment in more detail. The damper housing 32 may be have a lip 42 around its open end, and the piston may be provided with lugs 44 to retain it in the damper housing 32.

Other types of damper may be used between the two modules, for example conventional oil or air dampers.

The invention is not limited to damping between the kinematically coupled sensing module and stylus module. The damping may be provided on any kinematically coupled surfaces to limit the impact when they are brought together, prevent wear and damage to the kinematic elements and, where relevant, preserving the integrity of transducer deflections.

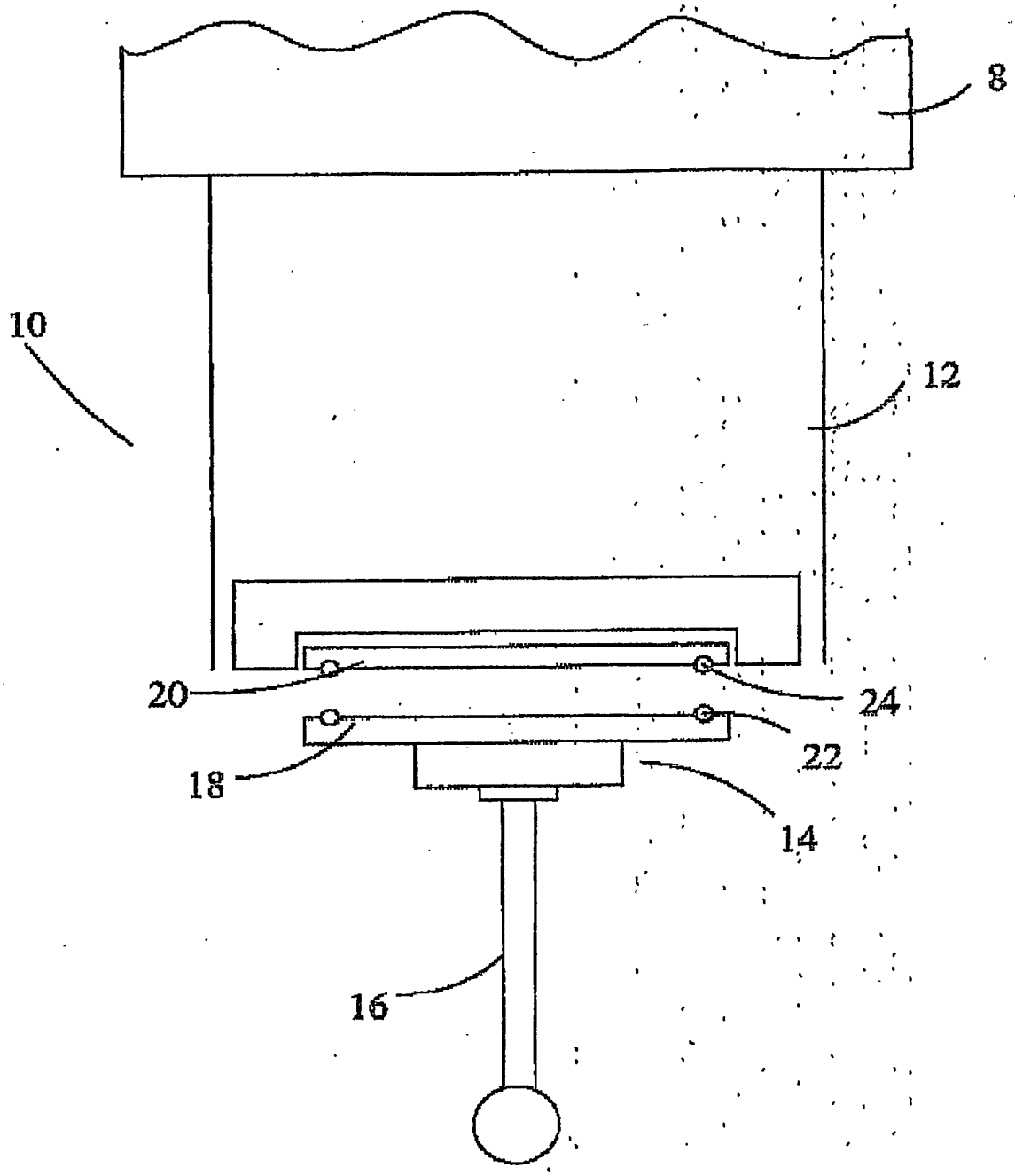

Fig 1

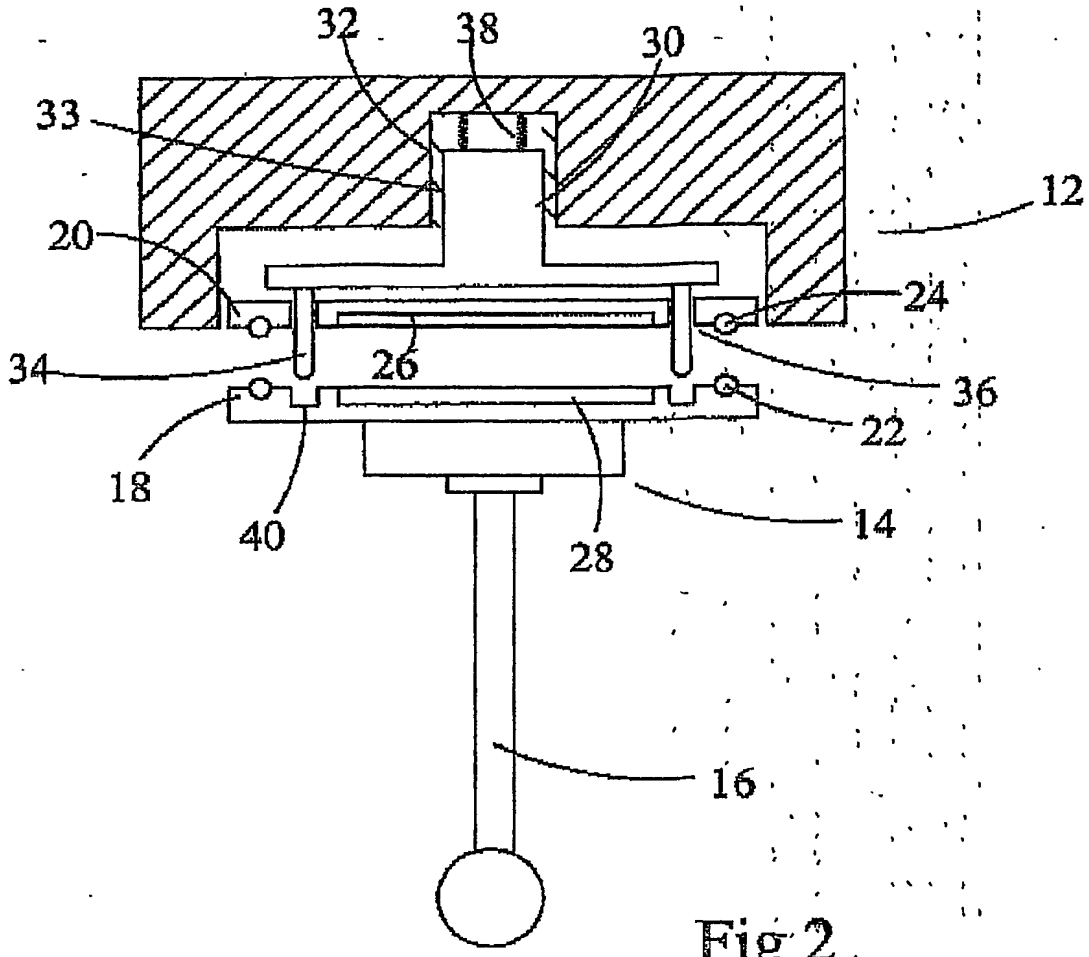

Fig 2

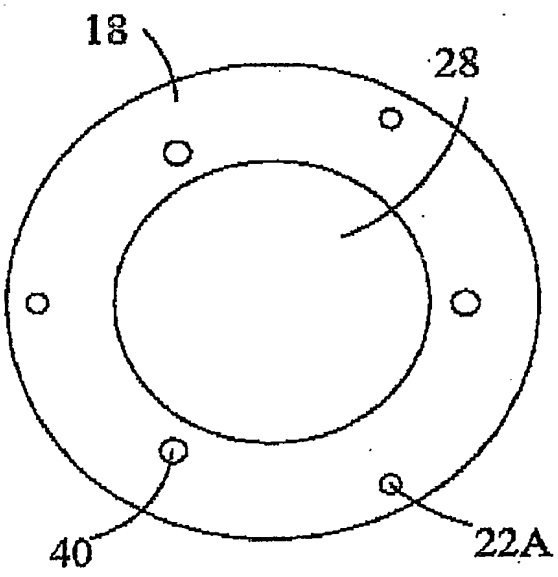

Fig 3

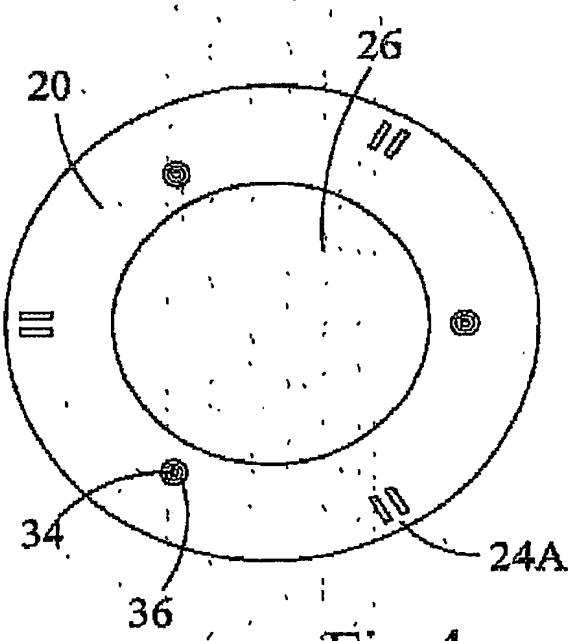

Fig 4

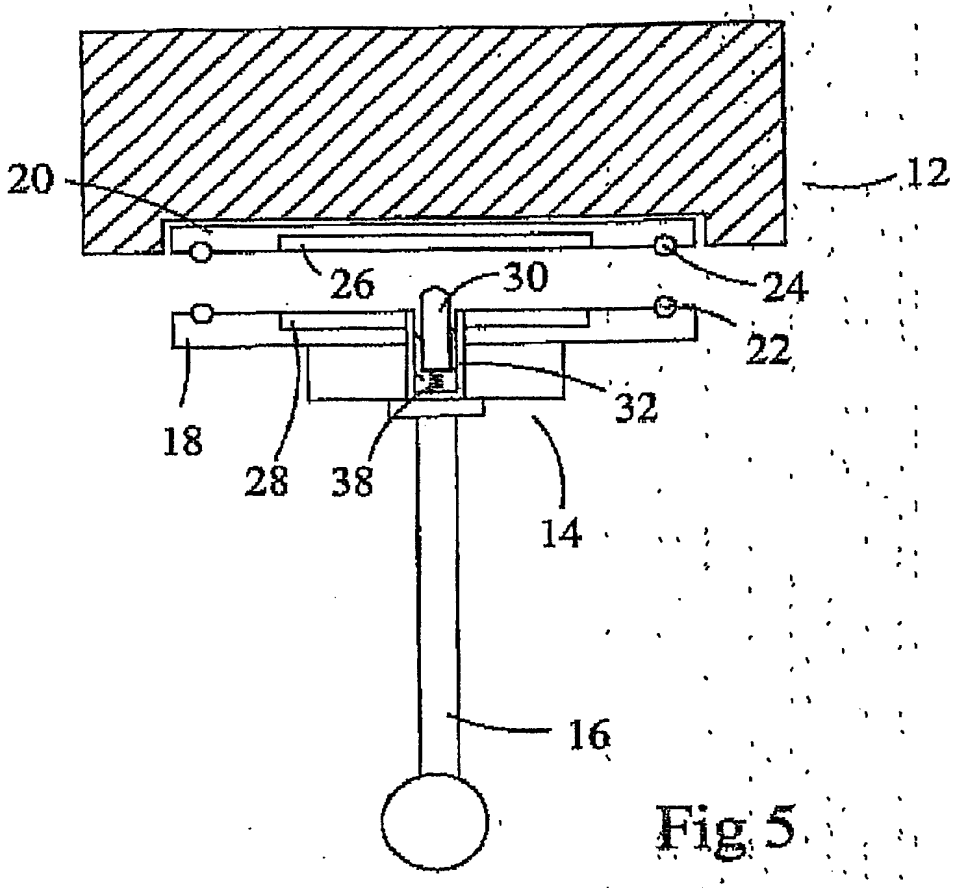

Fig 5

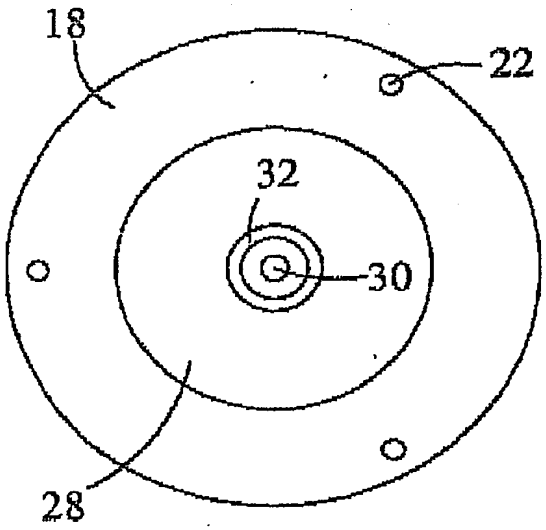

Fig 6

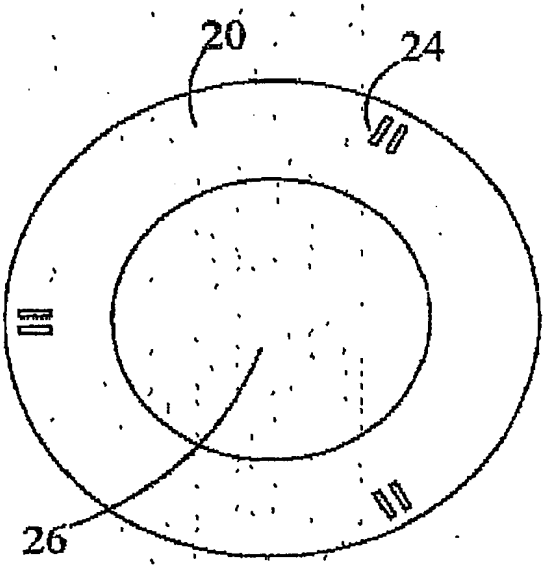

Fig 7

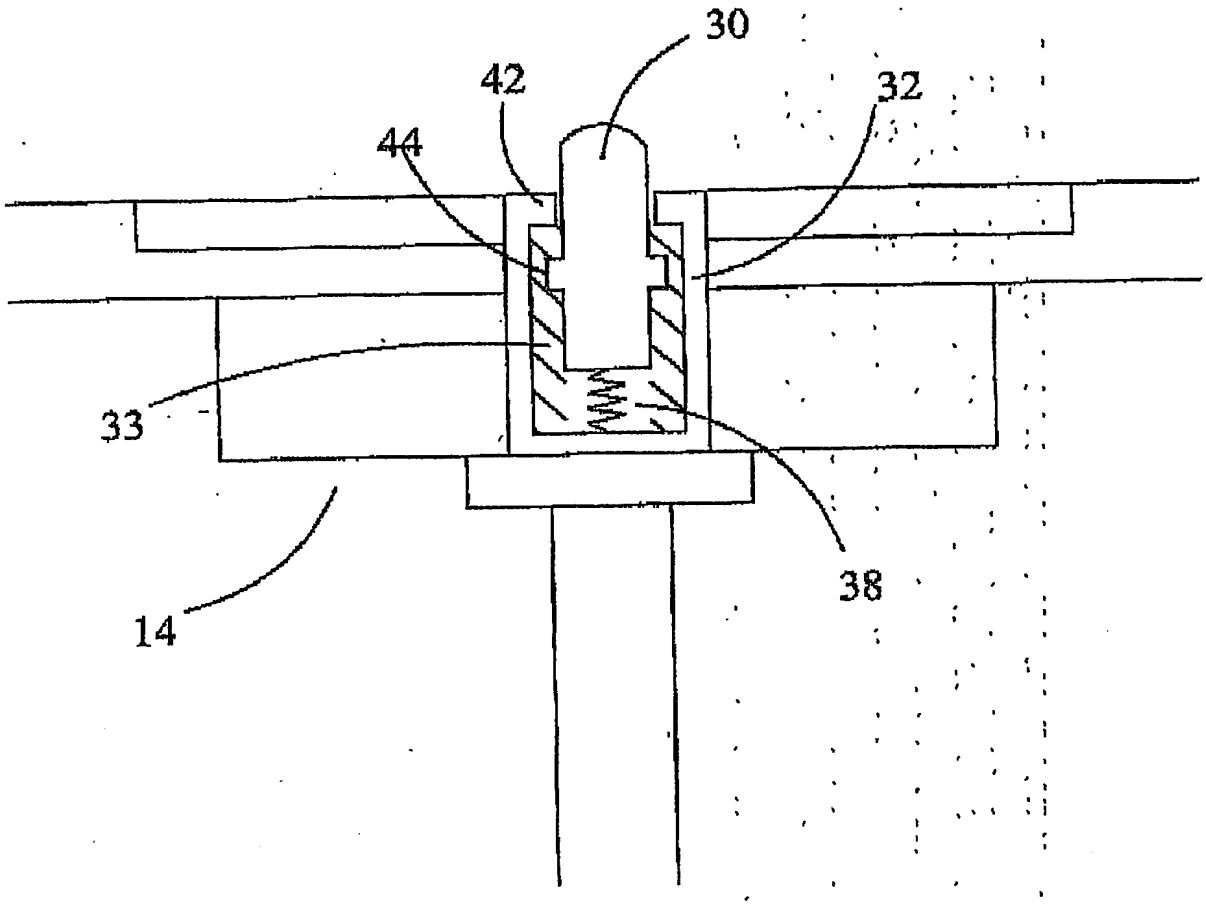

Fig 8.